AMERICAN JOURNAL of PHARMACY

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A Record of the Progress of Pharmacy and the Allied Sciences

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THE AMERICAN
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VOL. 99 NOVEMBER, 1927 NO. 11

EDITORIAL

PHARMACY WEEK IS OVER

PHARMACY WEEK is over. There is no doubt of the *partial* success of its mission. To a public no longer kindly disposed to labeled "weeks" of all kinds—from "Darn Your Own Stockings Week" to "Count Your Many Blessings Week"—it nevertheless seems to have carried rather an impressive message—of the multifarious services of the neighborhood pharmacist.

But "labeled" weeks are becoming something of a nuisance. They have so cluttered the calendar that it is quite possible that Congress may have to legislate special "rave-lengths" of time to the interests concerned. The story is told of a collector who essayed to gather his debts by informing a recalcitrant one that this was "Pay Your Back Debts Week"—to which the pay as you please customer reacted: "Sorry, but you know this week has been pre-empted by the Extension of Credit Club and I'm observing that." Fortunately, however, "Pharmacy Week" seems to have chosen upon a time distinctly its own.

In the cities one could hardly move about, during this "pleasing publicity" week, without a constant awareness of the spread of the gospel of Pharmacy. To the autocrat munching his shredded fodder, the morning paper insisted that his "druggist was more than a merchant"—nor could he, commuting to town in the Toonerville dancing trolley, escape the same conclusion—for the sign cards *insisted* too.

The drugstore man, just around the corner from the office, had lost every trace of his "inferiority complex," and his window, neat with a display of professional paraphernalia, caught the busy commuter's eye, and he paused long enough to study an experiment in complete percolation and to read a sign labeled "The Store of Ten Thousand Prescriptions."

To lunch with the Lions—and there too he invests a share of his dinner hour, listening to a college professor lionize the public-serving pharmacist.

Even the radio dedicated intervals between jazz and jazz to the business of asking the listener such questions as "Who fills your prescription?"

When the end of that day had come—and especially the end of that week—the urbanite and suburbanite alike had certainly their fill of Pharmacy.

It is rather difficult for one attached to the calling to disengage himself sufficiently, so that a viewpoint of vantage be had in the business of judging the real benefits of this kind of publicity.

But to this reviewer, irrespective of the impression which this week may have made upon the public, much more important is the impression which conceivably might be made on the pharmacist himself, and upon Pharmacy generally.

That others feel similarly about the matter is evident in this editorial * which we take the liberty of reprinting, in part:

> "Not only to the intermediate and the ultimate distributing divisions is the purpose of 'Pharmacy Week' one of promising opportunity, but it offers much which deserves as well the thought and the furtherance of the pharmaceutical manufacturer, the maker of ready-packaged medicinal preparations, the manufacturer of the raw and intermediate materials which enter into the production of these articles, and those whose business has to do with the natural products that constitute a large and important group in the multitude of materials embraced within the catholicity of pharmacal application. It would, unquestionably, be good for the whole drug trade and for the many industries which contribute to its demands, for the retail druggist to approach more closely, if not to return, to the drug business—to pharmacy, if you will; for 'pharmacy' is reasonably to be defined as comprising all service to the medicinal needs of the community, be they presented as simple calls for a packaged product or as demands on the special training of the prescriptionist. And with equal reason, all this service should be pharmacy's.
>
> "The drug store of today is most completely typical of that development in commerce, which is popularly styled 'the newer competition.' In the drug store, a score of industries, and more, meet in competition for the 'consumer's dollar.' In the majority of cases the share of this competition which falls to the drug

*From the *Oil, Paint and Drug Reporter.*

industry is by no means the largest. It is this which makes for the over-supply of drug stores and leads to the conditions in credit and in practice, which are not conductive to commercial health in the trade. Perhaps there is no remedy applicable to this trouble. It is difficult to conceive, for instance, how the noon-hour needs of metropolitan business centers could be served if drug stores did not function in the part-time role of lunch counters. But, none can deny that there would be a larger measure of economic soundness in a rearrangement which would apportion the drug business among the sufficient, lesser number of drug stores and turn back the remaining multitude of heterogeneous competitive sidelines to the trades to which they belong.

"The drug business, in itself, has enough problems to lead to an ardent desire on the part of all divisions thereof to be relieved of the additional problems which have come with the acquiring of a hundred appendages. If 'Pharmacy Week' is to be all that its name implies, its purpose must be as much one of elimination of externals as one of cultivation of fundamentals. This should be the thought in the minds of those who join in the furtherance of the purpose of the designated period; for pharmacy, to attain its potential growth, must have its roots in soil whose fertility is not sapped by a wilderness of underbrush. Its trunk and branches must be free from parasitic appendages."

When Pharmacy Week will have taught Pharmacy itself this lesson its mission will have been *completely* fulfilled.

IVOR GRIFFITH.

ORIGINAL ARTICLES

AN APOTHEOSIS OF HOKUM

By Henry Leffmann

TWO OCTAVO volumes lie before me. One is bound in boards with cloth, "blue, darkly, deeply, beautifully blue, as some one, somewhere sings about the sky." The other is simply paper-bound. The subject-matter of each concerns baking powder, Royal and Calumet. The essence of the dispute is "what is alum." Numerous experts of high standing give their testimony. In a multitude of counselors there may be safety, but in this case there does not seem to be clarity or certainty.

The gist of the issue is that one company placed on the market a baking powder containing sodium aluminum sulphate, known commercially as SAS, which, of course, being much cheaper than acid potassium tartrate used by the other company permitted serious competition. The tartrate company began to circulate statements to the effect that alum in baking powders constitutes an addition of an unwholesome substance, pointing out that its own product contained no alum. Complaint was made to the Federal Trade Commission (created by Act of Congress in 1914) that the crusade by the tartrate company was unfair competition. After much testimony and argument the referee appointed by the F. T. C. decided against the complainant and the application for restraint was dismissed.

Of the two questions raised in the dispute, one may be left without decision here, namely, whether the introduction of a substance containing aluminum sulphate into baking powder renders the same less wholesome (or more harmful) than the use of acid tartrate. In the welter of testimony given by various experts on this subject, no definite conclusion can be reached, notwithstanding the positiveness of many of the statements. It must, of course, be borne in mind that when the baking powder is used, the aluminum sulphate is completely decomposed producing an aluminum hydroxide. The question of wholesomeness must, therefore, be discussed in this aspect, and the coincident presence of sodium sulphate with more or less colloidal organic matter, especially proteins and carbohydrates. The testimony adduced at the hearings tended to show that no specific

effects followed the rather free use of mixtures containing aluminum sulphate, but it does not seem that enough information has been acquired to base absolute statements as to harmlessness of such a substance used over a very long period. Those who were defending the use of aluminum preparations made counter charges against the tartrate powders on the basis that the final result in that case is sodium potassium tartrate, a laxative, but the sodium sulphate that results from the alum powders is also in that class.

The more important issue in the contest was as to the meaning of the word "alum." The material used as a substitute for cream of tartar is sodium aluminum sulphate, and it was specifically denied that this can be called "alum." Yet the natural response of the independent chemist to the question as to whether this should be a called "alum" seems to be affirmative. The mere substitution of another member of the alkali group does not change the several purposes for which alum in employed. It is the aluminum sulphate that is the active and desired ingredient, the other sulphate being merely used as a vehicle as it enables the aluminum salt to be crystallized in definite form and of definite composition. As might be expected, much reference was made to the U. S. P. and some to the N. F. These have become legal standards of recent years, under food and drug laws, Federal and State, but it does not seem that they are standards in general commercial relations or that the chemist is bound by them in matters outside of food and drug examination and control. As bearing upon the subject it will be worth while to find what the U. S. P. has designated as alum in the course of its existence. The alum of our forefathers was potassium alum ("potash alum," they called it). Along about the time of Civil War, the recovery of ammonium compounds from gas-liquor, enabled ammonium sulphate to be produced cheaper than potassium sulphate and it was substituted without much publicity. No noticeable difference appeared. Both compounds crystallize in the same form, with strictly analogous chemical composition, and as the use of the compound, as noted above, is almost exclusively for the aluminum salt, the substitution did no harm. The economic motive simply was back of the substitution. The makers were not furnishing a better article: they were simply furnishing one of which cost less.

The following is the series of designations of "Alumen," "alum" in the U. S. P. giving only the alkali-sulphate:

1820	potassium
1830	"
1840	"
1850	"
1860	"

In this revision, "aluminum and ammonium sulphate" was introduced as a special salt, but not called "alum"

1870	ammonium

Potassium aluminum sulphate now appears as a special salt not termed "alum"

1880	potassium
1890	"
1900	"
1910	potassium or ammonium
1920	"

It is apparent from this series that the framers of the U. S. P. considered only the question of presenting aluminum sulphate in a definite form, so as to be sure of the composition of the substance. This is the basis of the official list, to give certainty to each drug so that it may be used in prescribed dose or application with assurance that neither over nor under-dosing will occur.

There seems, therefore, to be no reasonable doubt that if sodium aluminum sulphate was placed on the market in satisfactory condition, competing in price with either the potassium or ammonium salt, it would be called "alum" and displace the other salts as the ammonium alum displaced the potassium form. The gist of the matter is, of course, that the aluminum sulphate represents an unusual and therefore suspected ingredient in food, but the tartrate company could have made no progress with the public by merely stating that the competing company was using an aluminum compound. The public knows nothing of such technical matters, but knows "alum" as an astringent and irritating substance. The fact that there is no alum in the material after the dough is made is also one that cannot be brought before people at large with any satisfaction.

The details of the testimony as given in the pamphlet published by the Calumet Company show vividly the decline of both legal and expert methods. Time was often wasted by unnecessary qualifying of experts, most of whom were eminent enough to be heard on merely answering to their names and present occupations. The statements of experts were largely merely expressions of opinion and the whole question as to the possible harmlessness or harmfulness of the ingredients in commercial baking powders remains practically undecided. As to what constitutes alum, it can be said with fair reason that either potassium, sodium or ammonium sulphate associated in molecular proportion with aluminum sulphate may be designated by that term. Certain alkali metals such as rubidium, may also be substituted, but their rarity is such as to take them out of the race. The substitution of iron, chromium or manganese for aluminum would still leave the compound an alum, but the practical uses would be seriously affected. Likewise, the substitution of selenates for sulphates will leave the type unchanged, hence rubidium selenate united in molecular proportion with chromic selenate will give, in the anhydrous state, an alum in which in which no ingredient of common alum is present except oxygen.

A long and expensive litigation has been carried out to determine the difference between tweedledum and tweedledee.

For information as to the earliest use of any chemical term, we may generally expect aid from that great classic, Kopp's *Geschichte der Chemie*. It appears that the Greeks designated as "stypteria," the same substance as the Romans called "alumen." Under these names, however, were classed all substances with distinct astringent taste. Dioscorides always speaks of the substance as a natural product. Aluminum compounds were for a long while confounded with iron compounds, and no definite conclusions can be drawn as to the chemical composition of the substances designated by the Latin word "alumen." For a comprehensive review of the ancient and modern literature on the subject, a pamphlet by Dr. A. M. Patterson, with a preface by Dr. E. J. Crane should be consulted.

THE HELIUM MYSTERY: WHEN AND BY WHOM WAS THE ELEMENT NAMED?

By Henry Leffmann and Max Trumper

NO MORE romantic and impressive instance of the value of correlation between pure and applied science can be found than in the story of helium. Recognized at first in a merely speculative way by a line in the spectrum of the solar chromosphere, it was subsequently detected in small amount in some rare minerals and finally in notable amount in gas-wells. From being a substance expected to remain always indefinite to us, it has become a commercial product of special and most valuable applications, and the United States has the good fortune to have within its boundaries the largest supply so far discovered.

In view of the practical and theoretic interest attaching to the element, it would be supposed that the story of its discovery, early history and naming will be set forth in full and correct detail in the standard manuals. Such is singularly not the case. The bibliographies of the element are discordant. All, so far examined, have one or more serious inaccuracies. Five accounts are conveniently available. Mellor (A Comprehensive Treatise on Inorganic and Theoretical Chemistry, Vol. 7) and Kayser (Handbuch der Spektroskopie, Vol. 5) give extended series of references. Bulletin 178c, Bureau of Mines (a preliminary issue of 178) contributed by Dr. Andrew Stewart, and the Smithsonian Institution Report for 1918, in an article by C. G. Abbot, refer to the early data, but without definite references. The Bureau of Standards published in 1919 a "Bibliography of Scientific Literature relating to Helium" prepared by H. R. Weaver of the Bureau.

Weaver's bibliography may be conveniently taken as a text for discussion of the puzzle of the history of the element. It starts with two erroneous entries, namely:

> "Janssen. *C. r.* 1868, (67), 838. Discovery of new spectrum lines in the sun, since found to belong to helium.
>
> "Frankland and Lockyer. *Proc. Roy. Soc.*, 1868, (17), 91. Announce the existence of an element in the sun unknown on the earth and name it helium."

In the many bibliographies now found in text-books and journals there are few in which such peculiar errors are to be noted. Janssen's

paper contains no reference to spectrum lines. It is merely a letter to the Academy of Science at Paris stating that he had observed in India the total eclipse of the sun on August 18, 1868 and further that he had devised a method of observing the spectra of the solar chromosphere without waiting for an eclipse or interposing a screen before the sun's disk.

The paper in the Royal Society's Proceedings is by Lockyer alone. Frankland is not mentioned. Lockyer, at that time was not F. R. S., and he sent the communication as a letter to the Secretary of the Society, which letter was "presented by Dr. Sharpey." In this letter he states that after many unsuccessful trials, he had succeeded in observing the spectra of the chromosphere and noted three lines, one coincident with C, one nearly coincident with F, and one near but more refrangible than either of the sodium lines. No mention is made of any supposition as to the last-named line indicating a new element, let alone proposing any name for it.

In judging of these reports, it must be borne in mind that in 1868 the spectroscope was a comparatively new instrument. The first important application of it to chemical research was the discovery of cesium in 1860. It appears from Lockyer's first paper that the construction of an instrument applicable to astronomical research had been much delayed and that he had been also delayed because he had to develop a new field of investigation.

In the Bureau of Mines paper, Dr. Stewart follows the view of the Bureau of Standards pamphlet, asserting simply that Janssen saw the yellow line near the sodium lines and that Frankland and Lockyer called the element helium as the line was not referable to any terrestrial element then known. Kayser, in the extensive bibliography of helium in the work above mentioned, does not give any reference to Janssen.

From examination of the earliest literature bearing on this subject it seems that the important point in Lockyer's and Janssen's respective observations was the elucidation of the chemical nature of the solar chromosphere, which was shown to contain hydrogen. Jenssen made his studies in India, continued them after the total eclipse, apparently reaching somewhat briefly the method of observing the spectral, but Lockyer worked in England and was occupied for some time with his efforts. The distance of Janssen from Paris caused his communication to the Academy of Sciences to be delayed

until about the time when Lockyer presented his letter to the Royal Society. Some discussion took place in both societies concerning priority, but in the French Society Faye spoke in a conciliatory tone, urging that it might be considered a fortunate circumstance that distance had so to speak equalized the date of publication of the report and instead of disputing over the matter, both scientists should be given equal credit for the epoch-making work. In the literature of the period there does not seem to be any definite statement as to the significance of the line more refrangible than the sodium lines, but it was so designated as D_3.

The New English Dictionary, which purports to give the date of the earliest use of every word, so far as can be found in exciting literature, gives 1878 in this case, quoting from Newcomb's Popular Astronomy, but this date must be much later than the actual publication of the name. In a lecture about 1894, Lockyer said that he coined the name as a laboratory term.

The later story of helium, its detection in certain rare minerals and then in appreciable amounts in the natural gas of the southwestern part of the United States, is clearly set forth in the bibliographies.

It seems certain that Lockyer coined the name, but the first announcement to the scientific world seems obscure. It is to be regretted that he assumed a metallic nature, for we now know that "helion" would be more appropriate.

An interesting point, concerning which there is some misunderstanding, is the relative lifting powers of hydrogen and helium. As the latter is double the sp. gr. of the former it is often assumed that it has but half the lifting power. A simple calculation using approximate numbers will show this to be a mistake. If we take a volume of hydrogen as weighing 100, the same volume of helium will weigh 200 and of air about 1440. Subtracting the two amounts from the air-weight, we get

1440	1440
100	200
1340	1240

Hence helium has about 90 per cent. the lifting power of hydrogen, *i. e.*, $\frac{12}{13}$

PLANT AND ANIMAL ANALOGIES AND SIMILARITIES*

By Albert Schneider, M. D., Ph. D.

THE RECENT WORK by Gordonoff and others on the pharmacology of chlorophyll and by Manoiloff on the similarities of the sex qualities of hemoglobin and of the green coloring matter of the chloroplasts has awakened renewed interest in the study of the analogies and the similarities of plants and of animals. When the cell theory of living things became a recognized and admitted fact, there was a tendency to consider the members of the great kingdoms of living things as probably closely kin, but soon the plant physiologists arrived at the conclusion, based upon inadequate observations and faulty methods, that instead of similarities there was rather an antithesis, at least physiologically and also morphologically. Plants give up that which animals require and *vice versa*. These earlier crude concepts need not be reviewed. Every student of botany in our secondary schools and colleges has listened to the current ideas along that line. The higher institutions of learning (universities and colleges) have remained rather silent. For many years nothing worth while has been done along the lines of plant physiology, at least not in this country. The classical investigations by Strassburger, Haberlandt, and others in European countries have been initiated and copied here and elsewhere but no one has had the courage or the energy to build upon these labors. It remained for a Hindoo, Jagadis Chunder Bose, to make the first important addition to the general physiology of plants, with special reference to the similarities in the functional activities of plants and animals. The investigations by Bose have received much laudatory comment in the British and Hindoo press but in this country the criticism has been largely adverse. Thus the editor of THE AMERICAN JOURNAL OF PHARMACY (Editorial of the March, 1927, issue) prompted by the bitter criticisms of two American botanists, MacDougal and Overton, feels called upon to apologize for a rather favorable though reprinted comment in an earlier issue. Both the editorial comments and the criticisms by the two botanists mentioned are faulty and do not harmonize with the experimental data and conclusions as recorded by Bose. Bose's statements, suggestions and conclusions are based on a very thorough investigation, done with

*Read at the Plant Science Seminar 1927.

the use of the most modern apparatus, including an Einthoven string galvanometer, and the observations and conclusions by Bose are not "information obtained from communion with the unseen and the unknown—with the intuitive and the imaginative," quoting the words of the editor of *The Garland* (Calcutta). It is perhaps regretable that Bose uses the expression "nerves," in reference to the stimuli conducting phloem tissue of the vascular bundles; but even that is no more remote from the scientific verities, than are the expressions "breathing pores" as applied to the stomata, or "hairs" as applied to trichomes. The stomata do not breathe in the sense that either man or monkey does, and the trichomes are not hairs in any way comparable to the blonde locks of an Adonis or a flapper. The investigations by Bose do indeed lack the thoroughness of some of the researches as they appear in the *Zeitschrift für Botanik,* for example, and are largely intended to clarify many of the general and basic facts regarding plant physiology, perhaps prompted to this investigation by a desire to ascertain in what way plants and animals are physiologically similar or analogous. The investigations themselves are worthy of the highest encomiums and it will no doubt be some time before another investigator will accomplish a piece of work which is in any way comparable, either as to scope or as to the patient skill displayed throughout.

That the hemoglobin of the blood and the green pigment of the chlorophyll grains are closely similar chemically has been known for some time, and lkewise is there a close similarity spectroscopically. This chemical and spectroscopic similarity is so striking that the biologist cannot refrain from considering the chloroplasts as the analogues of the erythrocytes and that red blood corpuscles are to animals what chlorophyll grains are to plants.

If we observe the movements of leaves as of the Mimosa, of the insectivorous plants, and the movements of tendrils, of trichomes, and of the stems of some aquatic plants, we are reminded of certain muscle movements of animals. It has been determined that certain plant tissues largely transmit stimuli, as the phloem elements of the vascular bundle; and that certain cell groups respond to the stimuli much as muscles respond to stimuli, revealing a latent period, a refractory effect, blocking effects due to the influence of freezing, chemicals and poisons, much as may be observed in any nerve-muscle preparation. The essential differences are that in plants the stimuli travel more slowly and the muscle-like responses are far more limited in range. Injuries to plants produce shock effects which are

biologically comparable to the shock effects following traumatization in animals.

Plants, in addition to the now familiar vitamins, contain endocrines and hormones. For example, extracts of plant ovaries contain endocrines and hormones which give rise to physiologic effects in animals similar to the effects following the administration of animal extracts (ovarian).

Manoiloff claims that the blood of the female (of the animal kingdom) contains a substance (perhaps endocrinal or enzymatic in character) different from that of the male and that through the seriatim application of certain simple test solutions it is possible to distinguish the sex of blood, and even to determine the sex of the unborn child. If the fetus is male it will, quite early in its development, transmit the specific sex enzyme or hormone or endocrine to the blood of the mother, and thus by applying the test to a few drops of blood obtained from the pregnant mother, it is possible to determine the sex of the unborn. This test, if workable, it would have a most important bearing in law, in forensic medicine and in criminal investigation. The work by Monoiloff has been adversely criticised by recent German investigators, it being asserted that the reactions are too uncertain and too variable and that there is no experimental evidence of the existence of a specific sex enzyme in the blood of animals. Other investigators apparently support the findings by Manoiloff. Furthermore, Manoiloff claims to have been quite successful in applying the test, with like results, to the chlorophyll from male and female plants of the dicœcious group (as hemp, the willows, the poplars, etc.).

The work of Gordonoff, in the pharmacology of plants, has been checked by other investigators. Grill has made a series of tests which would indicate that the ordinary earthworm (*Lumbricus terristris*) might be used to assay the chlorophyll preparations which are beginning to appear on the market, such as chlorosan.

There are many other interesting analogies and similarities between plants and animals which are beginning to attract attention and which point to the closer kinship of all living things.

North Pacific College of Pharmacy,
Portland, Oregon, July, 1927.

SOME INVESTIGATIONS ON HAY-FEVER POLLEN*

By Roland V. L. LaGarde

Scientific Assistant, Missouri Botanical Garden

DURING the seasons 1925 and 1926 there were carried out investigations in the laboratory of the Missouri Botanical Garden under the direction of Dr. G. T. Moore, director of the Garden, for the purpose of devising a key for the identification of hay-fever pollen grains, which occur in the air and in the respiratory organs. There were investigated and tested the pollen grains of fifty-five plants which are regarded as responsible for hay fever in St. Louis and vicinity. The investigations were made along morphological and microchemical lines and the results were summarized in a key and in synoptical tables as a complement to the key.

All mounts were made in distilled water. We determined at first size and shape of the pollen grains, and then the number of pores and the presence or absence of lids. After that we applied chemical tests to a number of water preparations of the pollen in question. The chemicals were added in very small quantities to avoid a too rapid reaction and to watch it in its gradual development. On samples taken from herbarium material, which had been kept for years in the herbarium, it was possible to identify size, shape, and even the pores, but none of the chemical reactions occurring on fresh material took place on dried specimens.

In general the pollen grains may be classified according to their shape either as spherical or elliptical. We can retrace the tetrahedral and all the different kinds of polyhedral shapes which occur, to the spherical shape and may classify them as modifications caused by the pores producing an angular surface, or by different surface markings. When mounted in water these shapes become especially distinct due to the difference in swelling of the pollen wall and the pores.

The prevailing size of the pollen grains examined varied from 15-40 microns in diameter. Some of the hay-fever plants investigated produce larger pollen grains, f. e. Ailanthus glandulosa (Tree of Heaven), Pinus Austriaca (Austrian pine), Taraxacum officinale (Dandelion), Polygonum persicaria (Knotweed or Lad's Thumb).

*Read at the Plant Science Seminar 1927.

For each species the size of the pollen grains is constant within the limits which have been determined. The prevailing color which is of no diagnostic significance was in most cases a yellow one; only few of the hay fever plants produce pollen grains with a brown, gray-yellow, a greenish-yellow color.

Important marks of identification are different surface markings like warts, spines of different kinds and shapes, irregular protuberances, reticulations, oil drops, etc. Of great importance (for the identification) are the openings in the pollen wall, commonly called pores. The pores are characterized according to the investigations of *Strassburger* as openings in the pollen wall, which are formed in the earlier period of development of the pollen grains. Both layers of the pollen wall—exine and intine—are on these places replaced by a homogeneous tissue which is distinguished from the tissue of the pollen wall by a greater capability of swelling. Usually that tissue grows and swells forward over the margin of the pore, finally covering a part of it and forming a lid. In some cases is formed only a closing membrane.

We can make the pores distinctly visible with the aid of certain chemicals. Of course, different effects will be obtained by treating with certain chemicals or stains. The common used well-known staining solution gave no satisfactory results; therefore we used a staining solution of our own composition, a combination of acetic acid and Nigrosine Gruebler, which gave satisfactory results in all cases. That staining solution, we call it "Acid Nigrosine," is made as follows: To 100 cc. of a 2 per cent. acetic acid solution is added 5 cc. of a saturated and filtered ethyl alcoholic solution of nigrosine (Gruebler). After mixing thoroughly by shaking the reagent is ready for use.

In general we can distinguish four different classes of openings in the pollen wall.

(1) Pollen grains with large pores, covered with a lid.
(2) Pollen grains with large pores without a lid (but with a delicate membrane).
(3) Pollen grains with large and very small pores (the large pores with or without a lid).
(4) Pollen grains with a great number of very small pores.

In *case one* the acid passes through the lids into the contents while the lids, acting as a filter, hold back the nigrosine and retain it, appearing dark violet.

In *case two* staining solution passes through the lids unfiltered and penetrates the contents in a very remarkable way. Instead of staining the contents evenly, as it should be supposed, the stain takes a definite outline from the openings to the center of the pollen grains in form of a cylinder or cone. When the stain has reached the center of the pollen grain as many cylinder—or cone-shaped stained areas can be distinguished as there were openings in the pollen wall. Later, however, the stain may spread throughout the contents; but it is always possible to identify the number of openings in the pollen wall by counting the number of cylinder or cone-shaped regions.

In *case three* the lids of the large pores show the same reaction as in cases one and two; but at the same time, however, the stain enters through the small pores and slowly penetrates the contents. If lids are present on the large pores, they appear stained, whilst the places beneath the pores remain unstained. If the large pores are not covered with a lid the stain will enter through both the large and the small pores, but more rapidly through the large ones because of the larger surface of opening. In both cases we can easily determine the number of large pores and the presence or absence of lids.

In *case four* with numerous fine pores, the stain enters the contents at many places and makes its way rapidly to the center, staining uniformly the contents. To obtain the best results it is necessary to add only small quantities of the reagent—drop by drop—to the water preparation. By using this new staining method we have been enabled to determine easily the kind and number of openings in the pollen wall of the fifty-five kinds of pollen grains investigated.

An exception seemed to form the pollen of Pinus austriaca. This pollen, as the pollen of Conifers in general, has two air-sacs. At first no reaction could be noticed, but after a time, however, the tissue of the air-sacs slowly began to take the staining color finally assuming a dark violet color. This result, compared with the results obtained with other pollens, shows that the tissue of the air-sacs takes the nigrosine in the same way that the lids of the pores do. The nigrosine is stored in the tissue of the air-sacs, while the acid penetrates the tissue and makes its way into the air-sacs and farther into the pollen grain. It stands to reason that the tissue of the air-

sacs might be regarded as nothing but an enlarged lid of a pore which is concealed below the air-sac in the pollen wall. Since the pollen of Pinus austriaca has two air-sacs we may conclude that most probably the pollen grains have two pores with lids which have expanded to produce the air-sacs.

I mentioned that the pollen grains have been tested with a series of chemicals and stains, commonly used in botanical microtechnics. Only the tests with three mineralic acids (sulphuric acid, hydrochloric acid, and nitric acid), three alkalies (ammonia water, sodium hydroxide, and potassium hydroxide), and with iodine solution (iodine water and Lugol's solution) gave reactions, which are of any value for identification. It is necessary, to obtain the best results, that only small quantities of the reagent in question be applied.

In concentrated sulphuric acid the contents and the intine are dissolved, they swell and creep out through the pores very rapidly; often the pollen grains burst. Color reactions are confined to the ectine. In Wormwood (Artemisia absinthium), New England Aster (Aster novæ Angliæ), and Common Sunflower (Helianthus annuus) have been identified yellow pigments, which gave in concentrated sulphuric acid the typical reaction of lipochromes. As this reaction is very distinct and specific for the pollen of these three plants, it can be used as a mark of identification.

In nitric acid mostly a swelling of the whole grain took place.

The reactions in alkalies are mostly color reactions.

The tests with iodine solutions showed that among the fifty-five cases investigated in thirty-four cases starch could be determined unquestionable. The size of the starch grains varies from very small to large ones (0.5-1.7) and is a distinguishing mark of great value for identification.

Other reagents with which the pollen grains have been tested were the following: 95 per cent. ethylic alcohol, acetone, acetic acid, chromic acid, Biuret's and Millon's reagent, vanilline, aniline sulphate, and diphenylamine. No changes took place except in one case. The pollen wall of the pollen grains of the White Bent Grass (Agrostis alba) showed a swelling in 1 per cent. chromic acid. The tests with Millon's reagent gave a positive result only in 11 per cent. of the cases investigated: Common or Lesser Ragweed (Ambrosia artemisiæfolia), Lamb's Quarters (Chenopodium album), Bermuda Grass

(Cynodon Dactylon), Common Dahlia (Dahlia variabilis), White Oak (Quercus alba), and Scarlet Oak (Quercus coccinea).

During the summer 1926, a start was made towards a survey of the air in St. Louis and vicinity. Microscopical slides covered with cotton seed oil were exposed daily and the occurring pollen grains identified. The observations extended over 115 days; but only on fifty-one days were positive results recorded. Pollen of Common or Lesser Ragweed occurred in 30 per cent. of the cases, the pollen of the other hay-fever plants occurring only in smaller amounts—15-1 per cent. The pollen survey will be continued through several seasons.

OCCURRENCE OF HÆMATOPORPHYRIN IN URINE FOLLOWING ADMINISTRATION OF TRIONAL

By Frederick G. Germuth

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Historical

THE OCCURRENCE of hæmatoporphyrin in the urine under normal conditions, in traces, has been recognized for sometime past;[1] (numbers refer to references) its presence in larger amounts in certain pathological conditions is generally acknowledged.[2] Hammersten[3] first isolated it in a crystalline state from the urine of insane women after sulfonal intoxication, while Salkowski[4] is credited with having first shown the presence of this pigment in the urine after administration of this hypnotic.

Formation

It is believed that the production of hæmatoporphyrin from hæmin necessitates the formation of two carboxyl groups existing latent in lactam combination, in the hæmin. The chemical composition of hæmin is expressed by the formula, $C_{68}H_{64}N_8O_8Fe_2Cl_2$; that of hæmatoporphyrin is $C_{34}H_{38}N_4O_6$. It is evidence that the conversion of the former to the latter involves a process in which the iron is split off.

Characteristics of Two Hypnotics

Sulfonal is, properly speaking, diethylsulfon-dimethylmethane. Trional corresponds to the chemical compound, diethylsulfon-methylethylmethane. As is obvious, in the latter compound, an ethyl group has replaced the second methyl group present in the sulfonal, producing a rearrangement in the alkyl grouping. Trional finds wide employment as a sedative to induce sleep where pain is absent; sulfonal possibly is utilized to a greater extent. The therapeutic properties of both are somewhat similar, and the dosage employed practically identical. The chemical composition of Sulfonal is represented by the formula $(CH_3)_2C(SO_2C_2H_5)_2$ that of Trional is $C_2H_5.CH_3.C(SO_2C_2H_5)_2$.

Procedure Adopted

It was deemed desirable to investigate the probable effect of trional ingestion on the production of this specific porphyrin., to ascertain what difference, if any, might be produced by the trional as a result of the molecular structure.

Accordingly, samples of urine, five in number, representing the twenty-four hour output of patients to whom trional had been administered, were employed.

Five sample of normal urine were examined also, obtained from patients for whom neither of the hypnotics had been prescribed, and of whom it was reasonably certain none had indulged in previous to entrance.

It was considered important to examine, in addition to the two classes of urines mentioned, five samples of the fluid from persons who had been using sulfonal; a comparison of the relative quantities of the porphyrin present in the samples constituting, it was believed, data of some value.

The patients from whom the urine was obtained had been taking the hypnotics concerned in this paper for at least thirty days prior to examination (in several cases over a slightly longer period), the dosages employed varying but little.

The Method

The method employed to detect the presence of the small amount of hæmatoporphyrin in the samples of normal urine was that of Garrod., this being considered the most accurate method when the compound is present in minute amounts.

However, in the examination of the urine from the treated patients, the method of Salkowski was resorted to, this procedure insuring better results where the substance under examination contains more than a trace of the compound sought.

For the benefit of those who may not be familiar with the technique involved, it is given herewith:

A mixture consisting of equal portions (by volume) of barium hydroxide solution, saturated, and ten per cent. barium chloride solution is added to the sample of urine to be tested, precipitation of some of the solids resulting. This precipitate, which is washed at least three times with warm water (about 37 degrees C.) contains the hæmatoporphyrin.

This is permitted to stand one hour at room temperature, in alcohol containing hydrochloric acid (one c.c. of concentrated hydrochloric acid of specific gravity 1.20, in twenty-five c.c. of 95 per cent. ethyl alcohol), and then filtered.

The alcoholic filtrate is mixed thoroughly with a like volume of chloroform, and two volumes of distilled water added. This is carefully shaken, and a lower layer of chloroform is obtained which contains a very pure hæmatoporphyrin, while the upper layer of alcohol and water contains other pigments in addition to a small quantity of this compound.

The chloroform layer is colored a brownish-red, its intensity depending upon the concentration of the porphyrin present. It may not be amiss to remark that the color is believed by some workers to be produced in greater part by pigments other than hæmatoporphyrin, which have not been sufficient studied. Be this as it may, it is generally acknowledged that the amount of coloration produced is proportional to the quantity of the porphyrin present, and in view of this, the writer believes the tests made show the relative concentration of the compound under discussion, if not the absolute amount.

It may be mentioned here that the amount (and consequently the volumes) of reagents employed in each test was identical, hence the volume of chloroform solution similar in each case.

The following table shows the results of the treatment as outlined above:

INTENSITY OF COLOR IN CHOROFORM SOLUTIONS OF HÆMATOPORPHYRIN

	Normal Urine	*Urine (sulfonal)*	*Urine (trional)*
Sample No. 1	Trace	Brown	Deep Brown
Sample No. 2	Ft. Trace	Deep Brown	Intense Brown
Sample No. 3	Colorless	Brown	Deep Brown
Sample No. 4	Trace	Brown	Reddish Brown
Sample No. 5	Ft. Trace	Light Brown	Intense Brown

After examination of the colorations produced, each solution was carefully evaporated to dryness, and while there was some variation among the individual samples, the average results were in perfect accord with those given in the table.

The first five samples of normal urine contained but traces of the hæmatoporphyrin; the next five samples representing those ob-

tained from persons to whom sulfonal had been administered, contained larger amounts, while that of the trional patients was in excess of either. It is of interest to note that the amounts of hæmatoporphyrin produced in the trional urines was greater than that present in the urines of the sulfonal patients, in the relative proportions of: 1.0 sulfonal : 1.34 trional.

Discussion

The fact that an increase in ethyl groups present in the molecules of the compounds constituting this series of hypnotics imparts greater activity in therapeutic properties, is a matter of general observation. Thus, the compound dimethylsulfonedimethylmethane is of little value medicinally, while there exists a corresponding increase in the activities of diethylsulfonedimethylmethane and diethylsulfonemethylethylmethane.

It is evident, therefore, that Tetronal, chemically known as diethylsulfonediethylmethane, possesses the greatest activity. This conclusion is verified by observation attending the employment of the soporific in question in experimental clinical studies. It would be of interest to learn in this connection whether the continued use of Tetronal produces an amount of hæmatoporphyrin in theoretical excess of that caused by the administration of Trional. In view of the facts presented by the author, it would appear feasible in the absence of experimental data, to anticipate this condition. Undoubtedly, the production of hæmatoporphyrin in urine following administration of either of the compounds under consideration is influenced by the molecular alkyl structure, an increase of the ethyl radical producing or causing a proportionate increase in the amount of the pigment present in urine. Apparently, the replacement of the methyl radicals by ethyl groups, while augmenting the soporific power, is most favorable also to the physiological conditions governing the formation of hæmatoporphyrin in the human system.

Summary

It is believed that the employment of diethylsulfon-methylethylmethane, in permissible or larger amounts produces a greater proportion of hæmatoporphyrin in the urine, than diethylsulfon-dimethylmethane, under similar conditions.

It is interesting to observe in this respect that the color of urine from patients who have been using the former soporific, is slightly more intense in shade than that taken from sulfonal patients.

This statement applies to even a greater extent to the chloroform solutions of the porphyrin, that due to trional exhibiting a deeper shade than that of sulfonal.

In summarizing, it may be remarked that the test described could not find employment for determining trional or sulfonal intoxication, and has not been advocated for this purpose, as the presence of hæmatoporphyrin in urine has been observed in certain eruptive diseases (typhoid, etc.); that is, in larger quantities than normal amount; however, the facts presented constitute work prompted and undertaken wholly with the desire and objective of showing the relative effects of trional and sulfonal as regards the production of a particular urinary pigment, the rôle of trional being heretofore obscure in the reaction considered.

Apparently, the substitution of the ethyl radical for the methyl group with the resulting compound diethylsulfon-methylethylmethane has a tendency to increase the amount of hæmatoporphyrin produced as a result of the ingestion of this hypnotic.

Acknowledgment

The author takes pleasure in acknowledging his indebtedness to Dr. Harry Goldsmith, Physician-in-Chief of the Psycopathic Department, Baltimore City Hospitals, for supplying a portion of the samples of urine employed in the tests.

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POISONING BY SOLUBLE BARBITAL

By Frederick G. Germuth

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SOLUBLE BARBITAL is the sodium salt of diethylmalonylurea. The facts in the following report are of considerable importance and interest in view of the present-day extensive use of the drug as a hypnotic, the facility with which it can be obtained, and the apparent rarity of poisoning by it. The case is also interesting from the excessive amount taken, and the physiologic conditions developed.

On July 27, 1927, I was requested by Dr. Lawrence Fahrney, resident physician at St. Joseph's Hospital (Baltimore) to test for this compound in the material removed from the stomach of a patient then in the hospital. In the event of the detection of the drug I was asked to determine the amount. It was stated also that the patient had been treated on the preceding day for poisoning of similar character, having been discharged as cured on that day. At her reception at the hospital on the second occasion now under consideration she seemed to be suffering from a drug of greater potency than that taken in the first instance. First aid treatment was given, the stomach contents removed and, as noted, submitted for analysis. The patient had meanwhile passed into unconsciousness and the condition was considered critical.

The standard methods for determining the drug were at once carried out very carefully and an amount in excess of sixty grains was found, a determination which I feel confident is correct. I was kept informed of the progress of the case by daily reports from the nurse in charge of the ward (St. Mary's) of the hospital. For three days following her admission, during which she was, of course, receiving constant attention, she remained comatose, but on the fourth day occasional periods of subconsciousness occurred, which condition obtained until the sixth day when full consciousness returned. She became excited, gesticulating wildly, speaking incoherently and trying to leave her bed. An opiate was administered intravenously, which took effect satisfactorily and later, when the effects of this passed off, she improved steadily and was discharged as cured on the tenth day after admission.

While the symptoms in this case are those known as the general effects of the drug, it is believed that the dose taken is much in excess of the amount usually employed. It seems to be that the instance points strongly to the necessity of regulating the sale of this drug by conditions similar to those now in force in regard to certain well known narcotics. A physician has reported to me an instance in which a person suffering from dental caries purchased a drug (luminal) which is extensively used for epilepsy and some kindred disorders. It appears also that the patient in the case above described was subsequently recognized as a drug-addict. Dr. Harry Goldsmith, physician to the psychopathic ward of the Baltimore City Hospital, informed me, in a private communication, that during January, 1927, she was undergoing treatment for excessive use of paregoric. I do not know why she developed a preference for a derivative of the poppy in place of that for the synthetic product.

WHO FILLS YOUR PRESCRIPTIONS?*

By Charles H. LaWall

BEFORE I can intelligently discuss this question I shall have to ask another.

What is a prescription?

The average person who receives the written and signed order authorized by a physician who has been legally entrusted with the responsibility involved in such service, does not appreciate the fact that the prescription as such is a very ancient factor in the history of medicine and pharmacy.

There were prescriptions written in pictorial characters on papyrus in Egypt in the days when King Tut was laid away in regal splendor.

There were prescriptions written on clay tablets in cuneiform script by Babylonian physicians in the time of Nebuchadnezzar.

There were prescriptions written on parchment in Latin and Greek in the period of Aristotle and Alexander, and there were prescriptions written in Arabic on paper during the dark ages which elapsed between the time when Rome fell and the crusades began.

The prescription therefore has a history as old as civilization itself and has always been an important factor in the treatment and cure of disease. Do you happen to know that the little stroke across the tail of the letter ℞ is a relic of the hazardous times in pagan Rome when physicians in order to avoid the imputation and hazard of being connected with the Christian religion used the sign of Jupiter, (♃), which looks somewhat like a figure two with a stroke across the tail, to indicate their conformity with the classic faith of the empire.

This astrological symbol, for such it really is, was used for over fifteen hundred years and is found in pharmaceutical and medical works as late as the eighteenth century. Many who used it did so in the superstitious belief that they were invoking the aid of Jove in favor of the patient.

All that remains now of this superstition and this ancient custom is the tiny stroke across the tail of the ℞ which distinguishes it from the ordinary letter of that name.

*A Radiotalk, given by Professor Charles H. LaWall, during Pharmacy Week, 1927, over station W. I. P. Philadelphia.

Let us come back now to the original question. Who fills your prescriptions?

If your prescriptions are properly filled this question may only be answered in one way by saying, "They are filled by a pharmacist."

This confronts us with another obvious question.

What is a pharmacist?

A pharmacist is one who has been educated in the sciences to an extent necessary to qualify him for the important duty of filling prescriptions and dispensing medicines and poisons.

May a physician then not fill his prescriptions himself?

Yes, he may do so and all physicians dispense medicines in cases of emergency, but the physician who fills as well as writes his own prescriptions, except in case of emergency or for some other very good reason, is establishing a side line in which he is not properly qualified either by training or experience to do justice to his patient in the manner and form in which the medicine is administered. It is the function and responsibility of the physician to diagnose diseases and recommend treatment. If medicines are required, the wise physician writes prescriptions to be dispensed by competent pharmacists for this is the pharmacists particular province and specialty for which he has been especially trained.

When I use the term pharmacy and pharmacist in this talk I intend the words to be understood in the restrictive professional sense in which these terms are employed in the laws governing such service.

It is true that many, if not most pharmacists, engage in merchandizing other lines more or less remote from drugs and medicines, but if proper professional service is also rendered this need not be looked upon as in any way discreditable.

Pharmacy is a highly specialized calling requiring a collegiate education, most of which is concerned with a study of scientific subjects.

Pharmacy may rise to the dignity of a true profession or it may sink to the level of the lowest kind of commercialism, according to the ideals, the integrity, the ability and the training of the one who practices it.

The drugs and chemicals used by the pharmacist in filling your prescriptions are brought from all parts of the world, and the interest both scientific and romantic that is associated with many of these adds a spice and a zest to the calling which lures many to the ranks of pharmacy.

The true pharmacist must be an individual possessing a high degree of integrity, for he is entrusted with the great responsibility connected with the sale and dispensing of powerful poisons. He is the legal custodian of narcotic drugs and alcoholic liquors which may be supplied only upon physicians prescriptions.

Whether he is a manufacturer of his own stock of medicines or not, he must be familiar with their properties and responsible for their quality, strength and purity.

He must also be familiar with their uses and doses, with the constant realization that in his hands frequently lie the issues of life and death.

The pharmacist must possess a wide fund of general scientific information, for in matters of sanitation, hygiene and other important public health subjects he is more frequently consulted than any other member of the community, not even excepting the physician himself.

The true pharmacist has accepted and lives up to a professional code of ethics which closely resembles that of medicine in its history, its scope and its idealism.

Does the pharmacist who fills YOUR prescriptions fulfill the foregoing conditions. There are many conscientious members of the profession who do fulfill these conditions and who are ready and anxious to serve you at any time. There are also in existence certain parasites of the calling, or pseudo pharmacists, who besmirch the good name of Pharmacy to satisfy their own selfish commercial interests.

Do you select your pharmacist with the same care that you choose your physician or your dentist?

Is your pharmacist a man of undoubted integrity, one who keeps up to date in his scientific knowledge and holds membership in the associations which represent the progress and the ideals of his profession?

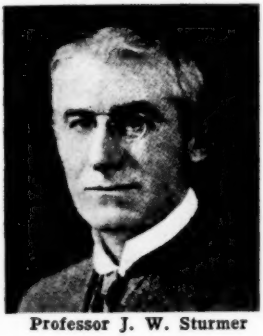
Has your pharmacist observed pharmacy week?

If you can answer all of these questions in the affirmative then you may be assured that your prescription is in safe hands, for the great majority of pharmacists come up to the foregoing specifications, and when the public becomes more discriminating in its selection of professional service in pharmacy when it is needed, pharmacy week will have attained its object for it was primarily instituted to enable pharmacists to prove to their patrons and their communities that in the words of a modern slogan "Your druggist is more than a merchant." He is a pharmacist.

THE STORY OF BURNT CLAY*

By Professor J. W. Sturmer

THE AFFINITY which a small boy exhibits for mud is proverbial. He loves its oozy, squashy consistency, and learns quickly also that mud of sufficient firmness, may be shaped into most realistic biscuits and pies, which harden in the sun, so that they may be handled without losing their form. Of course, some mud serves better for this purpose, and some is not so good. He learns—empirically—to choose his mud.



Professor J. W. Sturmer

The small boy's interest is in a plastic, or moldable material—not in its chemical make-up, its constituents, or their formation. But we grown-ups may with profit devote some time and effort to a scientific study of the mud.

The automobilist who has traveled over mud roads in all kinds of weather will tell you of roads so slithery that his tires failed to obtain traction, and of baked-mud ruts almost as hard as cement, which his wheels could not crush. We all know that mud varies surprisingly in its nature and its behavior.

It is the clay soil on the farm which bakes hard, the clay in the road which forms the ruts that become so troublesome, the clay in the mud which adapts it to the needs of the young hopeful who has an imaginary order to fill for a dozen biscuits. And it is the clay constituent of earth which makes it suitable for pottery.

Now what is clay? Like mud it seems to vary endlessly in its color and its behavior. Obviously the clay which we dig up at any given spot is contaminated, is indeed a mixture of several well-known ingredients. In color it may be white, cream, buff, red, bluish, green, or of some compromise shade or tint. It may be extraordinarily plastic, or it may lack this property. Let us ask the geologist about clay.

*One of a Series of Popular Lectures given at the Philadelphia College of Pharmacy and Science, 1926-1927 Season.

He tells us that pure clay is white, like pure chalk and that, chemically, it is a hydrated aluminum silicate, or hydrated alumino-silicic acid, with varying ratios, however, of aluminic oxide to the acidic silicon dioxide. He tells us, next, that it is produced in nature's laboratory by the weathering of rock; that its formation has been in progress through the ages, and that it is still being formed, before our very eyes, if we will but take the trouble to look. He will explain that, in substance, "the eternal hills," built of layers of solid rock, are not as enduring as we might suppose, and that the "gnawing tooth of time," gradually but surely wears them down, the resultant rock debris forming the soil in which we grow our crops. This weathering of rock is essentially a chemical progress, although physical agencies are operative also to a considerable degree.

WHAT IS CLAY?

If the question were asked, what kind of rock is most enduring, and fit for monuments which are expected to last through the ages, the answer will probably be, *granite*—this hard conglomerate rock, which is made up of several dissimilar constituents, particles of which are plainly in evidence to the naked eye. Now, granite is composed of quartz, and mica, and feldspar, the latter a substance particularly susceptible to chemical changes by natural agencies. Chemically, feldspar is a double silicate of aluminum and of an alkali metal—with sodium, or potassium, or both of these. The effect of water, aided by carbon dioxide, on this mineral, feldspar, is to remove the salt of the alkali metal, and to leave the aluminum silicate, which, in a hydrated condition, that is, combined chemically with water, is clay. So feldspar yields clay. Other minerals of similar chemical composition also yield clay. And if the feldspar is quite pure, and the product of its decomposition is not subsequently contaminated with other rock debris, it is white. Such white deposits occur sometimes in the vicinity of the parent rock, the weathering of which produced the clay. But more frequently we find clay that has been transported by water to distant places, and in its travels has not only become contaminated with other substances, thus acquiring distinct and varied colors, but it has been also worn down to fine particles which exhibit the characteristics of colloids, characteristics by virtue of which the clay develops marked plasticity. Clay of this character, which is found in a deposit remote from its parent-rock, is called *secondary clay,* while the clay

HOW CLAY IS FORMED

which has not been transported, is purer, but not so finely subdivided, is known as *primary clay.*

Both varieties are used in pottery; the latter kind mainly because of its whiteness; and the other, because of its plasticity, for primary clay, unless it is mixed with other appropriate substances, cannot be molded. On the other hand, very plastic secondary clay may be too highly colored to be used by itself, and, what is more important, cannot be baked without undergoing distortion of form.

CLAY AND POTTERY

We know now that soil forms plastic mud on the addition of water, if it contains enough clay, and if the latter in part at least is in the colloidal state. That is to say, clay in colloidal particles—particles from .0001 to .000001 m.m.—is accountable for the plasticity and stickiness exhibited by certain soils, which makes it possible to use such soil for making molded objects like mud pies, and likewise, bricks, and other baked-earth products. On drying, such plastic clay becomes friable, but the addition of water restores the plasticity. If, however, the clay is heated sufficiently high, say to 300° C. to 500° C., the plasticity is destroyed and cannot be restored. But if soil does not contain an adequate proportion of colloidal clay, it will not cake, will not form hard ruts, and cannot be molded. Of course, most any earthy matter can be made to stick together by high heat, heat sufficiently intense to partially fuse the material. Even sand, which is silicon dioxide, and is chemically identical with quartz, can be fused. But it takes colloidal clay to make earth plastic with the addition of water.

It must be remembered that the distinction between glassware and pottery is not only in the nature of the ingredients, but also in the mode of production. Glass is an artificial rock which is plastic and moldable at a high temperature. Pottery is artificial rock produced at a temperature much below complete fusion. Glass is molded after it has been produced. Pottery is produced by firing after the molding operation, which is carried out on the raw material, this having been made plastic by admixture with water.

POTTERY AND GLASS

Since it is true than sand fuses, and most other rock substances fuse when the temperature is high enough, it follows that any kind of soil could be made into some kind of bricks, or into some kind of ware resembling pottery, provided that the shaping or molding were

accomplished at an extremely high temperature. But as a matter of fact, the development of pottery making has been altogether along the lines involving the use of earths which exhibit plasticity on the addition of water, making possible a molding or shaping process, to be followed by baking or firing.

The industry of making pottery is extremely ancient, far more ancient than the beginning of the recorded history of the human race.

THE ANCIENT ART OF POTTERY

Before the Egyptians learned to make records on papyrus, the dwellers in the valleys of the Euphrates used their clayey soil to make brick; they inscribed their historic data on tablets of clay, and rendered these permanent by a baking process. No one knows who first made the artificial building stones, which we call bricks, by baking clay. But the ruins of the temples of the Chaldeans exhibit bricks which look very much like the bricks we use at the present time; and the explorations now being carried forward in that region of Western Asia, show below the baked brick temple walls more ancient which were constructed of sun-dried brick.

How old, really, is the potter's art? When did man first observe to a purpose the sun-baked footprints made in clay soil? When did he learn to smear his rudely woven basket of twigs with clay, to dry this in the sun, to subsequently bake it over a fire, and thus to obtain a serviceable container for grain? How far back in the remote past is the stone age? And when were stone vessels first supplemented with vessels of baked clay? We know only that such vessels—even rudely ornamented with thumb-impressions, as we expect to see them on the crust of a home-baked pie—are shown in certain European museums as authentic specimens dating back to the stone age.

Certainly, of all the arts and handicrafts of today pottery-making is one of the most ancient. To be sure, it has experienced advancement in many directions. It started as a rude handicraft, developed into an art, and more recently, experienced its principal progress because of the advent of the engineer, whose triumphs have been along the lines of scientific factory production, with automatic machines performing most of the work formerly done by hand. Furthermore, science is replacing, very largely at least, the rule-of-thumb procedure of the past in the choosing of the raw material, and in the control of the details of manufacture. Thus, for example, our an-

ENTER THE ENGINEER AND THE SCIENTIST

cient pottery, like our bricks, were made of mud just as it happened to occur in nature. If perchance such pottery was superior, either in appearance, strength or in imperviousness to liquids, it was due to the fact that the mud, as a happy accident, contained, naturally, the ingredients which make good pottery. In other words, the clay used contained the right sort of impurities. This accounts, for example, for the excellent qualities of certain early Chinese ware.

The modern potter, however, does not depend upon luck to provide him with his raw material, mixed in the right proportions in nature's workshop. He uses, it is true, certain secondary clays, like the "ball clays," which are far from being pure hydrated aluminum silicate; and because of this, a degree of uncertainty still exists until actual factory trials have been carried out. But speaking generally, he has learned to compound his earths so as to achieve the desired results. Of course, common bricks, and crude pottery, are still made of clay soil as it occurs in the field. And at this point we may profitably note certain facts about bricks, and their manufacture, which will help us to understand the fundamentals of pottery in general.

BRICKS AND THE FUNDAMENTALS OF POTTERY MANUFACTURE

We note for example that some bricks are extremely porous and can absorb a large quantity of water? Why are they porous?

There are also non-porous bricks which are very much harder and sometimes a bit distorted and of a darker color. What causes the difference?

Suppose we visit an old-fashioned brickyard, where the engineer and the efficiency expert have not as yet installed complicated mechanical devices to divert our attention. We find here that the clay soil is worked to a homogeneous putty-like consistency in a machine operated by horsepower, the poor beast being compelled to follow his nose around a circle, slowly but continuously, for a long time, thus revolving the machinery which works a kind of huge dough mixer. Then the pasty mud is forced out of an orifice and molded. Next the cakes which are the bricks-to-be, are dried. Finally they are stacked in a kiln, and the firing does the rest. After the fire has died down, and the bricks have cooled, these are taken out, and sorted. Those which were remotest from the fire are a little larger than the other bricks, are paler in color, are quite friable, and very porous and absorbent. The bricks which were in direct contact with the fire and the fuel gases, are smaller, sometimes distorted, and may exhibit a brown,

black, bluish, or greenish color. These bricks are very hard, non-absorbent, and are characterized as vitrified—an adjective derived from the Latin word, virtrum, meaning glass. The bricks which occupied an intermediate position with reference to the fire and the fuel gases, are also intermediate in point of hardness, porosity, size, and in depth of color. These are the bricks for ordinary house-building, while the paler and more friable bricks are usable for inside walls, and the very hard, vitreous bricks are reserved for specific uses where their distinctive properties prove of value.

POROUS AND VITRIFIED BRICKS

Now let us look for the reasons for these variations; reasons which we can find by studying the action of fire on these sun-dried cakes of mud. In the first place we must remember that these dried mud cakes still contain moisture or water, which gradually escapes as the temperature rises, and in so doing, develops porosity, to which is due the permeability to water of soft-burnt brick. We must remember also that clay itself is a *hydrated* aluminum silicate, or better, a *hydrated* alumino-silicic acid, which, at a given temperature gives up the elements of water, with the production of the latter compound; and that the escape of this further enhances porosity. Of course, this pre-supposes that the temperature at which enough molten material is produced to fill the interstices or pores, has not been reached when the heating is discontinued. If, on the other hand, the temperature is raised sufficiently, and the heating continued long enough, the glass-like bonding material entirely fills the pores, and the resulting brick is vitreous, hard and non-absorptive. Whether such a brick will be distorted in shape will depend largely upon the composition of the raw soil employed in the process, a subject which will be again referred to in connection with pottery.

COLOR OF BRICKS

Now as regards the color: The earth or soil employed in brick-making is invariably colored; but we cannot foretell the color of the finished brick from the color of the raw earth, unless we know its compostion, and know something, also, about the color changes effected by the firing process. Thus, the earth may be black with organic matter and elementary carbon, a color which disappears in the heating for obvious reasons. Or the clay may be buff colored with hydrated oxide of iron, which burns to a bright "brick red." A clay soil fairly rich in iron may, on the other hand, produce a white,

or cream-colored brick, due to the presence of certain constituents like calcium carbonate, forming calcium oxide, which interfere with the development of the red color. Nor is the relative iron-content indicative of the depth of color which may be expected, for so much depends upon the degree of subdivision of this iron compound. Furthermore, the reducing effect of the flue gases, when there in an inadequate supply of air, must be considered, for at a temperature sufficiently high, black oxide of iron, and also ferrous silicate, which is greenish, may be formed, and the brick may turn bluish, greenish, or black, because of chemical alteration of the ferric oxide. Such effects are sometimes produced intentionally, as is also the mottled or variegated appearance in brick, which is the result of alternately providing a reducing and an oxidizing atmosphere in the kiln.

The red color of brick develops progressively as the temperature rises in the kiln, until the maximum is reached, at about 1100° C. When the temperature exceeds this, the bricks turn brown, and eventually black or bluish black, because of the formation of much vitreous matter, and the reduction of the ferric oxide, with the development of iron silicates—results which, however, depend not solely upon the temperature, for the composition of the kiln gases must also be taken into account.

The dark brown or black bricks, so largely used in Flemish masonry, and very common in the old buildings of Philadelphia, are colored with iron and manganese; and sometimes the dark bricks are produced by manipulating the fires in such a manner that vitrification occurs before all the carbon has been burned out of the clay, and this carbon becoming fixed, serving as a pigment.

Fire brick is usually cream or buff in color—seldom red; for red-burning clays are usually not sufficiently refractory. But fire brick sometimes exhibit a brindled effect, due to black spots, which are the result of the decomposition of iron pyrites particles present in some fire clays.

Brick making is a most important branch of the ceramic industry, and is no longer carried on in the primitive and empiric manner previously referred to. But the limitations of time (and space) preclude a description of the modern processes which are indeed triumphs of engineering skill and illustrate the value of the application of science to industry. The important fact—to us—is that these

artificial building stones, common bricks, are burnt or baked clay, clay with such admixtures as are provided in nature. Tiles and terra cotta are likewise burnt clay—only formed in a different mold. To be sure, the clay must be carefully chosen, particularly from the standpoint of texture. But the same applies to bricks, when a specific type of brick is desired.

As has been stated, the melting point of pure clay is high, about 1750° C., which is comparable to the melting point of platinum.

IMPURITIES MAY BE DESIRABLE

Hence there would be great difficulty in making bricks or tiles, or any ceramic ware, for that matter, out of pure clay alone. But the impurities naturally found in clays appreciably affect the melting point. Indeed, it is to the impurities that we must look in brick clay for the production of the vitreous matter which serves as a bonding material, to bind together the unfused clay particles. Hence it appears that every deposit of brick clay has its own characteristics, not only from the standpoint of the color developed, but also in the extent of vitrefication resulting at a given temperature. And the same holds true in the manufacture of crude pottery.

Another point to remember is that highly plastic clays, containing a relatively large amount of clay in the colloidal state, are prone to shrink and crack considerably on drying, and that objects made of such clays, on firing, experience distortion.

Bearing these facts in mind, we can see how true it is that primitive pottery-making was a handicraft in which the elements of chance or luck figured largely, and that it was accidental when a deposit was found which gave good results.

A HANDICRAFT

The pottery of the American Indian, for example, falls in this category of ware made from a clay soil rather than from a mixture of materials. It is similar in character to our common flower pots, which is true also for the very ancient specimens of urns and vases found in Western Asia.

Flower pots are buff, or a shade of red, according to the iron content of the clay employed. They are fired at a comparatively low temperature. Hence the vitreous bonding material produced is small in quantity, and does not fill the pores developed in the drying and in the earlier stages of the firing, due to the escape of the water. We may compare the internal structure of such ware to that of a

popcorn ball in which the grains are stuck together by melted sugar. A flower pot, or similar ware, will, naturally, be pervious to water, and we may expect it to be rather friable, which indeed it is, just like a soft-burned brick.

But a higher temperature will, if the clay contains the right impurities, produce enough vitreous matter to make the ware impervious, a fact which was undoubtedly known quite early in the development of pottery. This higher temperature, however, also tended to distort the ware.

Now, in decorating pottery, using earthy deposits for pigments, it was found that some tended to form an impervious and non-porous glaze. So in time the expedient of covering the entire article with a glaze was thought of, and carried into execution. Thus developed glazed ware, which is now so extensively used.

But long before glaze had been discovered, the art of manipulating the plastic clay into shapely forms had made progress, and even the stone age specimens are not devoid of beauty of outline. In the early Egyptian era the potter's wheel came into use, a device which is employed to this day, making possible the symmetrical shapes of urns and vases.

SCIENTIFIC COMPOUNDING

If we except bricks, tiles, coarse pottery, like flower pots and similar ware, we may say that modern pottery is not made from clay soil, but from a material which is compounded, and in which ingredients of fairly definite chemical composition, and of known physical and chemical properties, play a part.

Modern pottery may be classified under the three captions, earthenware, stoneware, and porcelain.

Earthenware is absorbent, like a soft-burned brick, but may be of a much finer texture, and be nearly devoid of color. Our cheaper dinner plates, cups and saucers, are glazed earthenware, a very serviceable kind of pottery which was originated in England in the 18th century, by Josiah Wedgewood, the most famous potter of his day. Table ware of this character is, of course, always glazed, and is commonly known as queen's ware.

Stoneware is quite different from earthenware in that it is non-absorbent, impervious to liquids, and is very hard—hence the name. It is largely employed in chemical manufacturing because of its dura-

bility, and because of its being resistive to the action of acids and of many other chemical agents.

Porcelain differs from stoneware in that its fracture is glassy rather than stoney, and also in that it is translucent, while stoneware is opaque. China is really porcelain, and not a different type of ware, although in popular usage the word is sometimes used as a synonym for queen's ware, which is not correct, for the name China ware is derived from the fact that the first specimens of white, translucent pottery which reached Europe, had come from China.

Bone china is a particular type of porcelain in the production of which bone ash is used as one of the ingredients.

THE RAW MATERIALS OF THE MODERN POTTER

The principal raw materials for the modern potter are kaolin, ball clay, feldspar, and quartz or flint. From these may be made earthenware, stoneware, or porcelain, depending upon the type of clays used, the proportions, and the control of the temperature in the firing.

Kaolin is a white, lean clay, the term "lean" signifying that it is devoid, or nearly devoid, of plasticity. It is almost pure hydrated alumino-silicic acid, corresponding to the formula $Al_2O_3.2SiO_2.2H_2O$, and it has a high melting point, namely about 1750° C.

Ball clays are plastic clays, containing much colloidal material. They are contaminated with various impurities, and may be rather highly colored. They do not usually burn white, which is a drawback, and explains the use of kaolin to replace the ball clay as far as possible. Indeed, only enough of the latter is used to impart sufficient plasticity to the mixture so that it may be shaped or molded.

The feldspar is employed because of its fusibility, and it furnishes the vitreous material in which a portion of the clay and the quartz dissolve, thus forming a matrix for the unfused and undissolved particles.

Silicon dioxide in the form of quartz or flint constitutes one-fourth to one-third, by weight, of the mixture of raw materials employed in modern pottery. It is indispensable. Its purpose is to reduce shrinkage in drying, and distortion in firing. There is, however, little or no unchanged quartz in porcelain, or in any other ceramic product which has been subjected to high heat, for quartz, at high temperatures, undergoes definite modifications, and moreover, a portion of it combines with the fused feldspar to produce a glass, thus further enriching the matrix.

THE PROCEDURE

The first step in the process of pottery making is the production of an intimate mixture of the ingredients, which, with the exception of ball clay, are obtained in the form of a fine powder. Such a mixture is effected, not in the dry state, but by making a water-suspension of each ingredient, and then mixing the several liquids, called slips, an operation which is usually done in a ball mill. Next, the magma is passed through sieves, and then over electro-magnets to remove iron particles, should any be present. Following this the magma or slip is passed through a filter press, to remove the excess of water.

The cakes of clay-like material from the filter press are next worked to homogeneity in a mixing machine, from which the soft paste is forced in form of a cylinder. This may be cut into convenient lengths for the shaping operation, prior to which, however, the paste is sometimes "aged" to enhance the plasticity.

We have now a moldable mud, comparable to the mud from which bricks are made, but unlike the latter, of rather definite composition, the kaolin, ball clay, feldspar, and the quartz, in the proportions which experience, and many trials, have shown to work best for the type of ware which is to be produced.

There now remain the shaping, drying, and the firing.

CASTING AND MOLDING

For the shaping operation the use of plaster of paris molds is now largely resorted to with marked success. That is to say, many pieces of pottery are now made by *casting*. And for this operation the mud must be thin enough to pour, yet rich enough in solids to speedily form a layer or shell of deposit on the inside walls of the mold. To make such a suspension, sodium silicate, or sodium carbonate may be employed as a deflocculating agent. A small amount of either of these substances tends to make the clay paste quite fluid, despite the fact that it contains practically as much solid matter as a paste of the right consistency for molding with the hands.*

When the deposit on the inside walls of the plaster mold is adequately thick, the excess of the suspension is poured out, and

*This deflocculation is the opposite of the phenomenon occurring at the mouth of the Mississippi, where the fresh water, bearing great quantities of colloidal clay, merges in the salt water, at which point the salts flocculate the suspended solid matter, causing it to settle, and to gradually build up solid earth, a process which explains the delta formation at the mouth of this great stream.

when the shell of deposit has sufficiently hardened, because of the absorption of water from it by the plaster mold, the latter is opened, and the shell, which in this operation has experienced some shrinkage, can easily be removed. It is now carefully tooled, scraped and polished, to remove all blemishes, after which it is ready for the drying shelf, in the so-called "green room."

Some aricles, like cups, are cast in this manner, but while in the opened mold, are given their proper inside contour by means of a tool which is held in position while the cup whirls on a turn table, on which it has been carefully centered. This operation is called "jiggering," and may be used also when the clay is not cast, but is, in a plastic condition, pressed into the mold. The shaping tool is attached to a lever which may be raised or lowered as needed, from a support above the turn table. The whole apparatus is known as a "pull down." Many articles are neither molded, nor cast, but are shaped by hand, and with the aid of simple tools. Vases, urns, and jars, may be shaped on the potter's wheel, an operation which requires great skill, but which cannot be satisfactorily described.

When the ware has dried sufficiently, it is ready for the firing. The kilns used are conical in shape, are 16 to 18 feet in diameter, and terminate in a large smoke stack. The fuel now employed is either coal, or fuel oil.

THE FIRING

Before the fire is kindled, the ware is stacked in the kiln, to a considerable height. To make this stacking possible, and, what is more important, to protect the ware from direct contact with the flames, the individual articles are first put into containers made of baked fire clay. These containers are called "saggers," and stacked columns of them in the kiln are called "bungs."

When the kiln has been filled with ware, the opening is bricked up, and the charge is ready for the firing.

Firing pottery is an art—not a science, although recourse is had to scientific methods of temperature measurement and fire control. A pyrometer—a thermometer for high temperatures—is, of course, used. In addition, the operator in charge of the firing, puts into the kiln small cones of ceramic material of such composition as to soften and bend at certain definite temperatures. The cones, which are called Seger cones, in honor of the inventor, are fastened, upon a base in groups of three, the middle one softening at the temperature at which the ware is to be fired; the one in front of it, at a tempera-

ture a little below this, so as to give warning that the desired temperature has been approached; and the third, with a higher softening point, to show that this temperature has not been appreciably exceeded. In addition, rings of ceramic material may be used in the kiln, rings which indicate by their shrinkage, ascertainable by accurate measuring instruments, how far the firing process has progressed.

The temperature must rise just in the right manner and speed, must not exceed a certain height, must be maintained at that height just long enough, and the kiln must then be cooled at just the correct speed. The performing of such an operation is indeed an art. Yet to fail in it, means the ruination of the ware.

When the kiln has cooled, the fire bricks which closed the opening are taken out, and the ware is brought forth and removed from the saggers. It is now known as "bisque" or "bisquet" which is really a misnomer, for the word signified "twice burned," whereas the ware has so far undergone but a single firing. Whether it is porous and friable, or vitreous and hard, depends upon the composition, and upon the temperature employed. Crude earthenware is fired to about 750° C. to 1150° C., stoneware to about 1250° C., porcelain as high as 1500° C. The entire firing process takes from 24 hours to about two and a half days.

CHEMICAL CHANGES

During ths heating, a number of chemical changes take place. Hydrogen and oxygen in the proportion in which these exist in the water molecule are liberated, and escape in the form of steam. The quartz changes largely to cristobalite, which is one of the isomeric forms of silicon dioxide.

The kaolin, and the other clays, are converted into mullite, $3Al_2O_3.2SiO_2$. And the feldspar forms a molten glass which dissolves not only some of the clay, but also some quartz with which it forms a type of "acid glass," glass with an excess of SiO_2, comparable in this respect to the well known pyrex. The extent to which this glass-formation progresses, and the nature of the unfused and undissolved particles, determine the translucency of such ware as porcelain.

GLAZING

Our porcelain table ware is always glazed. So are many other modern ceramic wares. A glaze, as the word indicates, is a kind of glass. and there are many kinds. The glaze may be translucent, or it may be quite opaque. It may be colorless, white, or colored.

Stoneware is frequently salt-glazed, which is accomplished by throwing salt upon the fire so that it may be volatilized, and brought in contact with the ware. The salt reacts with the silicates at the high temperature, with the liberation of hydrochloric acid, and the production of a fusible sodium and aluminum silicate, which constitutes a very durable and highly satisfactory glaze, not, however, a particularly beautiful one.

A glaze which melts at a relatively low temperature is made with a lead base, and is in reality a kind of lead glass. Sometimes it is a boro-silicate, boric acid being used in its production. The "little brown jug" of song and story was lead glazed, as is much of our common coarse pottery.

Porcelain is glazed with a feldspathic glaze, consisting of pretty nearly the same constituents used in making the body of the ware, but more fusible than the latter, because of its containing also some lime. A common high-fire feldspathic glaze is made of feldspar, quartz, kaolin, and whiting.

The material for glazing is converted into a magma or slip into which the ware may be dipped--or the slip may be poured on, or brushed on.

The composition of the glaze must be carefully adjusted to the porcelain which it is to cover, particularly from the standpoint of thermal expansion, lest the glaze develop innumerable cracks, a phenomenon known as crazing. The hardness, and the tensile strength, and other physical properties, also have a bearing in precluding "crazing." In certain ornamental ware, as in a type of Chinese vases, crazing is intentional. But in case of table ware, particularly earthenware, the tendency to craze is a very grave imperfection.

While most glazes are glossy and translucent, there are also opaque glazes, this effect being produced usually by the addition of tin oxide to the formula.

Glazes, like glass, may be colored—blue with cobalt, brown with manganese, green with chromium, etc. The royal blue, so much admired in tableware, is cobalt rendered deeper and darker blue by the addition of zinc, or of boric acid, while a light blue may be obtained by using the cobalt in conjunction with alumina. Some pigments can withstand strong heating, while others are destroyed by high temperature, and must be used in connection with low-melting glazes. This is particularly true of the pinks and purples.

The decorations may be put on the bisque, and the glaze put over it, a procedure illustrated by much of our tableware. This method is known as "under-glazing." Over-glaze ware, on the other hand, is first glazed, then decorated, the decoration being burnt into the glaze by a low-temperature firing process. So it appears that the colors may be below the glaze, in it, or upon it. "China painting," as it is customarily carried out, involves the over-glaze procedure. While "hand-painted" ware is made industrially to some extent, the process known as decalcomania is more commonly resorted to in the "decoration" of tableware. The procedure is quite simple. The artist's original is reproduced by a printing process, on a soft paper. This is pasted—face down—upon the ware which has been coated with a thin varnish; the paper is soaked off in water, and thus the picture is "transferred," and may be imbedded in the glaze by firing. Decalcomania may be employed also in connection with the under-glaze process, in which case, however, the higher temperature employed in the glazing limits the choice of colors.

UNDER AND OVER

Our museums exhibit treasures of the ceramic art, from very ancient periods to the present time. It is interesting to note the improvements in perfection of outline, texture, ornamentation, and other details; to note when vitrified clay products first appeared, when glazes came into use, and when certain types of ornamentations had their initial vogue. Just as we have period furniture, so have we also period ceramic ware; and antiques in pottery are as much sought after as are the antiques in cabinet work. But the study of such matters is really historical, and is foreign to the scope of this lecture.

It is, indeed, a far cry from mud cakes to porcelain, or from the coarse pottery of ancient times to the beautiful objects of art which may now be purchased at a comparatively low price, thanks to the physicist, the chemist, and the engineer, who have transformed an ancient handicraft into a modern industry, organized for factory production. But essentially the story of ceramics is still the Story of Burnt Clay.

ABSTRACTED AND REPRINTED ARTICLES

THE CLINICAL THERMOMETER*

ITS HISTORY AND DEVELOPMENT

By C. J. S. Thompson, M. B. E.

THE CLINICAL thermometer now plays such an important part in the practice of medicine, that a short sketch illustrating the steps in its development may be of interest to the physician who has daily to rely on its valuable aid.

It was noted in early times that those suffering from disease often presented marked changes of temperature, but the importance of this observation was lost sight of for centuries. It was not until 1638 that attention was again called to the matter by Sanctorius, who constructed and advocated the use of a thermometer in the diagnosis of disease, and brought heat fluctuations into parallel with the fluctuations of bodily weight.

Nothing more was done until nearly a century afterwards, when Boerhaave turned his attention to the mechanical phenomena of the circulation. An important advance was, however, made by his pupil Van Swieten, who pointed out, that the heat of fever should be recorded by thermometers, as the sensibility of the physician's hand was quite untrustworthy. He recommended the employment of the mercurial thermometers made by Fahrenheit, and used them himself in the mouth and axilla.

The next step is due to De Haen, whose observations were made on a more scientific basis, for he noted the temperature of healthy men and discovered the increase of temperature in the aged. He observed the rise in temperature during rigor, the morning and evening fluctuations, the want of parallel between the temperature and the pulse, the thermometrical indications of the actions of drugs and other important points.

The subject attracted several English investigators about the middle of the eighteenth century, and an advance was made by Fordyce, who was afterwards joined by Blagden, Banks and Solander. Their experiments consisted in exposing themselves to high tempera-

*Reprinted from *Medical Life*.

tures in heated chambers, and thus they were able to establish and prove the independence of animal heat.

An interesting remark in connection with this, occurs in a letter written by Governor Ellis of Georgia, about this time, where in describing the great heat in the country, says, "a thermometer hanging at the end of my nose would often stand at 105°, while in close contact with my body I could never get it above 98°."

John Hunter, the great English surgeon, in his "Observations on the Animal Economy," published in 1786, recorded that the temperature of man is 1.5° lower during sleep, and gives a plate of a thermometer with a sliding scale which he used for experimental purposes.

The French chemist Lavoisier, who with La Place worked on thermometry, in 1780 observed, that animal heat generated in the lungs by respiration and was due to the combination of oxygen with hydrogen and carbon.

The next important step was made by Currie of Liverpool, who published his investigations under the title of "Medical Reports on the effect of Water, cold and warm, as a Remedy in Fever and other diseases" in 1797. The whole of his observations were based on thermometry, and he made careful records of the temperatures in his case histories. Currie's work, though it attracted little attention at the time, is remarkable, and is now historic, as he thus undoubtedly laid the foundations of modern clinical thermometry

It is interesting here to note, that Dr. Archibald Arnott, who was one of the physicians in charge of Napoleon Bonaparte, took the temperature of the ex-emperor on April 3d, 1821, when he was taken ill at St. Helena. Like Currie, he was a graduate of Edinburgh. In 1840, William Arnold, another Scottish physician, devoted a chapter in his book on the "Temperature of the System," to the use of the thermometer in disease, and notes that he took his temperatures under the tongue and in the axilla.

In December, 1852, Spurgin of Cambridge published a paper in the *Lancet,* in which he describes a thermometer he had devised, by means of which he states, "the medical practitioner can determine and record the relative degrees of heat of every part of the body, in health or disease." It consisted of an ordinary thermometer having its bulb and the lower part of its shaft suspended or fixed in a hollow cone of wood, so that the bulb descended nearly to the level of the lower rim of the cone. The portion of the shaft which rose out of the cone was affixed to a graduated ivory index, so the elevation of the mercury

could be readily ascertained. The shape of the bulb may be spherical, oval or elongated, and is bent at a right angle with the shaft. It is placed in the center of the hollow cone and receives the heat which emanates from the point of examination. These thermometers were made for the inventor by Biggs of St. Thomas Street, Southwark, and Weedon of Hart Street, Bloomsbury, London. Billings, who had charge of the wounded in the seven days before Richmond in the war in America in 1862, is said to have used a thermometer for taking the temperature of the body in cases of fever.

In Germany, Zimmerman, and in England, John Davy, published their physiological researches in 1863, which made a further advance, and in 1868 Wunderlich summed up the results of twenty years' researches in his historic work dealing with the subject.

About 1865, Aitken introduced his clinical thermometers which first began to be used as a novelty in the wards of English hospitals in 1866-67. They were formidable instruments about ten inches long, and took five minutes to register the axillary temperature, and were carried under the arm "like a gun." They were first made by Casella of London under the direction of Dr. Aitken, and were sold in pairs, one bent and the other straight, fitted into a mahogany case, with directions for use. In 1868 Arnold and Waters added a great deal to the then existing knowledge of the subject, especially in connection with the temperatures of typhus and typhoid fevers, and numerous experiments were carried out and carefully recorded by Breschet, Becquerel, Bouilland and Andral in 1869.

Clifford Allbutt was the first to originate the present short instrument in 1867, and his suggestions were carried out by Reynolds and Branson of Leeds. Sir Clifford says, "When I first designed pocket thermometers, I made them to fit within stethoscopes, but I did not like the result. The length of six inches in the stem is useful and is within the length of a stethoscope, but I found that a three-inch may be as accurate as a six-inch, and I had one made for my own use. At this time six minutes were considered necessary to record an accurate temperature." Allbutt's instrument had a chamber anterior to the bulb, and from six inches he first reduced the length to four, and finally to three inches. In the first type, the index was not separated but the chamber anterior was throttled at its side, so that the whole column was supported, until by a sharp downward swing the column was jerked backward to the anterior chamber, and so out of sight. The next development was the introduction of the air-speck index, by

means of which the column of mercury was more easily shaken down, and so by better workmanship the period necessary for registering the temperature has gradually been reduced from six minutes to thirty seconds.

From time to time, various suggestions have been made with regard to the shape of clinical thermometers, and instruments have been made in the form of a coil, and bent like the letter U, but none of these have proved better or more reliable, than the familiar short and reliable instrument at present in use.

MEDICAL AND PHARMACEUTICAL NOTES

SEASICKNESS.—Perhaps one of the most complete and interesting articles on seasickness and car (train) sickness is that in Billings' Forcheimer's Therapeutics, by Capt. C. S. Butler, of the Navy. He not only discusses the theory of seasickness in detail but he emphasizes the utter futility of drugging the vast majority of those who are being treated by bromides and sedatives. In fact, he attributes, as a result of such treatment, the conditions sometimes seen in severe cases, when artificial heart block has occurred, caused not by the seasickness but from the treatment. Captain Butler believes that a "clear head, a clear gastrointestinal tract, and a few words of encouragement and advice are the items the prospective passengers should get from the physician. Moderation in all things as a habit in life, but, if not that, then at least for a week before sailing, will accomplish the first item." For the second item he advises the pill containing aloin one-fifth gram (13 milligrams); extract of belladonna, one-eighth gram (8 milligrams); strychnine, the pure alkaloid, one-twentieth gram (3 milligrams); and ipecac, one-sixth gram (11 milligrams) in each pill.

In the November, 1925, number of the *United States Naval Medical Bulletin* there was an abstract from the thirteenth annual report of the United Fruit Company for the year 1924 of an article on seasickness by Dr. P. H. Desnoes, in which he mentions the hypodermic use of the drugs of the belladonna group combined with strychnine, but believes that he has secured better results with hyoscine hydrobromide, one four-hundredths of a grain by mouth every hour until the patient is relieved or until physiological effects are

obtained. In cases with much depression one-sixtieth of a grain of strychnine sulphate was added to this, and for severer cases with much vomiting the medication was given hypodermatically.

Although the number of cases that come under observation in the Navy are limited, it is believed from personal experience with Doctor Girard's treatment that it is not sufficiently known nor used as often as results warrant.—*(Naval Medical Bulletin.)*

THE BOTANICAL SOURCE OF EPHEDRINE—In the article on ephedrine in our June issue (pp. 228-230) the source of the alkaloid is given as *Ephedra vulgaris,* var. *helvetica,* but reference was made to the possibility of other species also yielding the alkaloid. The Chinese drug, *Ma Huang,* from which the alkaloid was first obtained, was at first thought to be *E. vulgaris,* var. *helvetica,* but some authorities say it is *E. equisetina,* and this source is ascribed to it by the Council of Pharmacy and Chemistry of the A. M. A. in their monograph.[1]

As mentioned in our article quoted above, the botanical source of ephedrine is discussed at some length by Holmes.[2] Some confusion seems to have arisen between the *E. vulgaris,* var. *helvetica* of Hooker and Thomson and the *E. helvetica* of C. A. Meyer; the latter in Holmes's opinion is a distinct species restricted to Switzerland, Italy, and France, and occurs in Japan as a cultivated plant. The plant called *E. vulgaris* is now known as *E. distachya,* Linn., and *E. onastachya,* Linn. The identity of *Ma Huang* appears to be doubtful, and Holmes thinks it probable that the species sold under this name in China is *E. intermedia,* var. *tibetica,* Stapf, *E. equisetina,* Bunge, and *E. monosperma,* Meyer. The last-named has been examined, and does not yield the same alkaloid as *Ma Huang.* The species that requires examination as regards its alkaloid, therefore, is *E. equisetina.* In a later communication Holmes[3] reports that a sample of *Ma Huang* sent to him for examination has the characteristic appearance of *E. equisetina,* Bunge. This, he adds, is imported from China into the United States by the ton for the extraction of ephedrine.

Commenting on Holmes's article, Read,[4] of the Peking Union Medical College, states that ephedrine and pseudo-ephedrine both occur in *E. equisetina,* and further that Chinese *Ma Huang* as collected by him differs from this plant in certain morphological characteristics.

Nielsen, McCausland, and Spruth [5] (Chicago) enumerate seven species of *Ephedra* stated to grow in the United States, and give the principal habitats of most of these. Though some of these are used in domestic medicine, none of those examined contained any alkaloid. The ephedrine manufactured in the United States is from imported *Ma Huang.* The alkaloid appears to be contained in the green branches only; the reddish-brown roots, trunks, and stems contain none. The content of the green branches is about 0.9 per cent.

While this note was in preparation, the editor of *The Prescriber* received a letter from Dr. Bernard E. Read, Peking Union Medical College, dated July 18, 1927, in which he refers to the article in the June issue and adds: "It is unfortunate that the source of ephedrine is falsely accredited as being *Ephedra vulgaris,* var. *helvetica.* There is an excellent content of this alkaloid in *Ephedra sinica,* Stapf, and *E. mahuang,* Liu. Of some tens of thousands of grammes of the alkaloid distributed from these laboratories the bulk has been used for asthma. The half-grain dose once daily is very effective and seldom shows untoward effects. This drug is of undoubted value, but people are apt to give too large and too frequent a dose."

It is evident therefore that the main source of ephedrine is *E. equisetina,* but that other species also contain the alkaloid. The Chinese drug apparently consists in the main of *E. equisetina,* but as is frequent in the case of Eastern drugs, other species may at times be mixed with it.—*(The Prescriber.)*

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ADRENALIN OF THE SUPRARENALS AND CADAVERISATION—Adrenalin rapidly disappears from the suprarenals within the body after death; therefore it is suggested that the glands should be removed

immediately after death if they are to be used in the preparation of the base.—G. Mouriquand and A. Leulier *(Compt. Rend. Soc. Biol.,* 1927, **96**, 1115; through *Chem. Abst.,* 1927, **21**, 2142).

A Colorimetric Estimation of Coal-Tar Disinfectants—Under the "Labelling of Poisons Act" it is necessary to state the percentage of phenols present in disinfectants made from crude creosote, and a simple method not necessitating distillation is obviously desirable. As creosol is soluble in water 1 in 50, it occurred to me that possibly a colorimetric test could be applied based on the well-known reaction between nitrous acid and phenols; this, I believe, has been suggested before for the estimation of small quantities of phenols for toxicological purposes. The following are the details of the test: Make a 1 in 200 dilution of the disinfectant in distilled water, mix in a test glass in the following order:

Dilute disinfectant (1-200) ..... 1 c.c.
Solution sodium nitrite (10 per cent.)..... 1 c.c.
Acid. sulph. dil., B.P..... 1 c.c.

Allow to react for fifteen minutes, agitating occasionally, add 5 c.c. Liq. Potassæ, then 50 c.c. distilled water, mix, and filter off 5 c.c. into a Nessler cylinder.

As a standard, I have used a 1 in 1000 solution in distilled water or *ortho-* or *para-cresol.* One c.c. of this is treated in the same way as the dilute disinfectant; but, of course, filtration is not necessary; 50 c.c. is used for Nesslerising, each 1 c.c. being equivalent to 0.4 per cent. of cresols in the original undiluted disinfectant. It is important that a fresh standard should be made for each test, as the colour darkens somewhat on standing. Several samples of disinfectant have been tested, and in every case the cresol content as shown by the above test has agreed closely with the amount stated on the manufacturer's label, thus showing that the test agrees well with the various methods adopted by manufacturers for the assay of their products.—(J. Rae, F.C.S., in *Pharm. Jour.,* London.)

NEWS ITEMS AND PERSONAL NOTES

PLANT SCIENCE SEMINAR—Dr. H. W. Youngken of the Massachusetts College of Pharmacy, was elected chairman of the Plant Science Seminar for 1928, Prof. Otto P. M. Canis was re-elected secretary-treasurer. The sixth annual Seminar will be held in Boston.

PHILADELPHIA COLLEGE OF PHARMACY BASKETBALL.—With high hopes and great ambitions the Philadelphia College of Pharmacy and Science enters into the less serious side of its school life, the basketball season. The plan this year is to repeat the success of last year by winning the championship of the Eastern Intercollegiate Pharmacy League, and duplicating this in their local City College League.

The first-mentioned league should be of interest to the pharmacists of the East as it is made up of teams representing Columbia, Brooklyn, Connecticut and Philadelphia colleges of pharmacy. Each team plays a home-and-home series around the circuit, and the leader at the end of the season is awarded the trophy. This is the league's second year, with Connecticut taking the place formerly held by New Jersey. Great things are being done here in bringing these people of the same vocation to closer relationship.

A NEW GENERAL ANTISEPTIC—A rather remarkable feature of a new general antiseptic, known as Solution-S. T. 37 (Liquor Hexylresorcinolis, 1-1000, S & D), is that, while it is actively germicidal and will destroy all form of pathogenic bacteria on less than fifteen seconds contact, it is non-toxic, safe and harmless if accidentally swallowed.

It requires no poison label, and is subject to no poison law restrictions. It is also odorless, colorless, stainless, non-corrosive, and is active in the presence of organic matter.

It is manufactured by Sharp & Dohme, and offered in three and twelve-ounce bottles.

WHAT THEY SAID 5000 YEARS AGO.—We have been reading some good counsels taken from what is called the oldest book in the world. It is in the Bibliotheque Nationale of Paris, its modern name is the Papyrus Prisse, and it is a copy, probably made before 2600 B. C., of a work compiled by Ptah Hotep, a Pharaoh of the Fifth Dynasty, who in about 3500 B. C., set down maxims of a still earlier date. Compared to this venerable Egyptian, Solomon is almost modern.

"Converse with the ignorant as with the scholar," says the oldest book in the world, "for barriers of art are never closed." When you talk with an angry man, do not be provoked with him, for "he is fighting against his very self." "It is better to live in the house of kindliness." This great books tells us that "to put an obstacle in the way of the laws is to open the way before violence." It declares, "If thou hast the position of empire, listen to the discourse of the petitioner." It urges that "love for the work they do bring men near to God; therefore, compose they face even in the midst of trouble so that peace may be with you."

Written more than five thousand years ago, these words are well abreast of modern thought, and considerably in advance of modern practice. The best the present age can claim for itself is that its practice may not be quite so far behind its precept as was the case in the days of Ptah Hotep.—*Cincinnati Times-Star,* through *The Eclectic Medical Journal.*

BOOK REVIEWS

PLANT ECOLOGY. W. B. McDougall. Viii-310 pp., 114 fig. Lea and Febiger, Philadelphia, 1927.

The work treats both of the relations of individual plants to the environment (autecology) and also the comparable relations of communities of plants (synecology). There are three chapters on the ecology of *roots, stems* and leaves. Symbiotic phenomena are divided into those of disjunctive symbiosis and those of conjunctive symbiosis. In each group the relationship may be either social or nutritive, and the nutritive relationship may be further subdivided into antagonistic and reciprocal. Discussed under symbiotic phenomena are such subjects are insectivorous plants, pollination, epiphytes, galls, etc. Fifty

pages are devoted to the environmental physical factors—gravity, light, heat, air, soil and water. Synecology is taken up under the following headings: Plant communities, the structure of plant associations, the classification of plant communities, plant succession (bare areas, the causes of succession, factors modifying succession, successions on sand, on rock and in water, etc.), phenology and the distribution of plant communities. There is a chapter on applied ecology discussing forest ecology, grazing problems, indicator vegetation, crop production, symbiotic phenomena and landscape gardening. An appendix is present for the teacher which contains suggestions both concerning laboratory and field work. References follow each chapter.

M. S. DUNN.

The well-known publishers of scientific books, Urban & Schwarzenberg, Verlagsbuchhandlung, Berlin and Wien, have submitted the two following works for review:

HANDBUCH DER PRAKTISCHEN UND WISSENSCHAFTLICHEN PHARMAZIE. Unter Mitarbeit zahlreicher Fachgenossen, herausgegeben von Geh-Reg.-Rat Prof. Dr. Hermann Thoms. Lieferung 21, Band VI, pp. 691 to 1200, Mk. 10.

This monumental work is nearing its completion. Vol. VI is devoted to Medicaments, both old and new remedies. Part 21, before us, treats in alphabetical order those from *Hæmo-Lecin* to *Kalmopyrin.* Each monograph is subdivided in Title and Synonyms, Formula, Molecular Weight, Occurrence, Manufacture, Physical and Chemical Properties, Tests for Identity and Purity, Therapeutic Action, Uses and Dose—truly a *"multum in parvo."*

Unlike the books on new remedies, here are also considered the old remedies. Three pages are devoted to Hydrargyrum Chloratum, $Hg_2 Cl_2$, giving also the old synonyms Mercurius dulcis and Aquila alba and the method of manufacture of the different varieties of Calomel.

This work when completed will constitute a pharmaceutical library in itself. Professor Thoms and his collaborators deserve thanks for the compilation of this "Handbuch."

REAGENZIEN UND NÄHRBÖDEN. Eine Zusammenstellung der wichtigsten und zweckmässigsten Vorschriften für die Laboratoriumspraxis. Von Dr. phil. E. Boehm und Dr. phil. K. R. Dietrich. Octavo, 375 pp., Mk. 18.

A splendid Book on Reagents, etc., compiled by two Berlin apothecaries, quite a credit to pharmacy. Its subdivisions are as follows: Reagents for Qualitative Analysis, for Quantitative Analysis, for Physiological-Chemical Analysis, for Bacteriological Analysis, Culture Media, Preservatives, Various Formulas, Appendix, Subject Index and Author's Index.

The authors have carefully sifted the literature of the entire world and have not forgotten our good United States, as we find in the Author's Index the names of the following Americans recorded: Benedict, Folin, Leffmann, Tscheppe, and others.

The book is well adapted for the library of the pharmacist as a ready reference book. Frequently the pharmacist is called upon to prepare a reagent, which he will surely find in the present book and can consequently turn it into dollars and cents.

OTTO RAUBENHEIMER, PH. M.

HUMANIZING EDUCATION. By Samuel D. Schmalhausen. Octavo, 343 pp., $2.50. The Macauley Company, 115 East Twenty-third Street, New York City.

The introduction of this book is as follows: "The problem of The New Education is briefly this: How to make unscientific minds scientific and scientific minds philosophic." The chapter headings are thus: Disillusionment: The Dawn of Wisdom; Critical-Mindedness: The basis of the New Education; Sex and Civilization: New Truth for Old; Our Intellectual Blind Spots; Human Nature in Reality; The Higher Learning: A Study in Wisdom and Folly; Appendix.

The author in a brilliant, graphic style and method examines our present educational formulas and shows wherein they stultify the mind. It is little wonder, then, that many educators and others acclaim this book for its stimulating proposals. It should have a splendid effect in liberalizing thinking, as well as helping students to orient themselves at a time when they need just such help.

It is a valuable and original work which should also be appreciated by pharmacists, teachers and students.

OTTO RAUBENHEIMER, PH. M.

THE ATOMIC SCIENCE. By Calvin Samuel Page. Octavo, 516 pp., illustrated, $5. Science Publishing Co., 25 North Dearborn Street, Chicago, Ill.

The Rx Atomic Science commenced with the discovery of the Energy of Repulsion and the new kind of atomic matter Rx in which it is alone inherent. This matter Professor Page named Rex and abbreviated it to Rx. This led to the discovery of the Energy of Cohesion possessed by all other kinds of atoms for Rx atoms only. Repulsion and Cohesion are the energy-phenomena which produce the other eight special spectacular force-phenomena: Heat, Light, Electricity, Gravitation, Magnetism, Capillarity, Chemical Affinity, Sound, and every other known force. Professor Page in the book before us presents a completely new understanding, which is logical and practical. Chemistry, next to mathematics, is the most definite knowledge of the sciences. The discovery of Rx and exactly what heat is, together with the Law of Molecules, do not only give a definite understanding of the modus operandi of chemical action, but will enable chemists to greatly increase their discoveries.

We wish the book the best success!

OTTO RAUBENHEIMER, PH. M.

A MANUAL OF CHEMISTRY. By W. Simon, Ph. D., M. D., and Daniel Base, Ph. D. 13th edition, enlarged and thoroughly revised by John C. Krantz, Jr., Pharm. B., Sc. D., University of Maryland. 8vo., 695 pp., numerous illustrations and 6 colored plates. Lea & Febiger, Philadelphia, $5.

Simon's Chemistry has been in use for many years. Its continued popularity is evidence of its satisfactory form. It was distinguished on its first appearance by the numerous colored plates showing chemical compounds, especially precipitates, and this feature is retained in the present edition. So far as the text at large is concerned it covers the usual data of chemistry as presented in standard manuals for students. An appendix gives some information about the spectroscope and polariscope and tables of the relation between the metric and the common system of weights and measures.

The colored plates that have always been so characteristic of the book are, notwithstanding the skill and care given to them, hardly of value. The only proper way for a student to get knowledge of chem-

ical compounds is by examining them or preparing them. We may select as an example of the indirection of the illustrations, that of ferrous sulphide on plate 1. It is deep black and in that respect is correct, but a similar color can be seen in several other sulphides, and after all the chemist's knowledge of the compound should be by several other properties more characteristic, color being often merely a function of physical condition. The same criticism applies to most of the other colored pictures. Surely no student would be called on to rely upon the picture purporting to represent the action of sulphuric acid and potassium dichromate on strychnine. The pictures add to the cost of the book. It may be that they add to its sale, but it is to be hoped that they may be omitted in the next edition. It is stated that the work has been thoroughly revised, but the table of atomic weights is dated 1922. The list does not contain hafnium, rhenium and masurium. Illinium is not included, although it is mentioned on page 203, and included in the chart of the periodic system (on page 199). It seems that the table of elements, atomic weights and symbols was printed from an old electrotype plate, especially as praseodymium is stated in a footnote to be also called didymium, and niton is used instead of radon for the radium emanation. On page 203 it is stated that ninety elements are known, but the list gives only eighty-three.

HENRY LEFFMANN.